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(54) **Reversible bone screw lock**

Knochenschraube mit reversibler Verschluss

Vis à os à frein réversible

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(73) Proprietor:
Sulzer Spine-Tech Inc.
Angleton, Texas 77515-4000 (US)

(72) Inventor: **KOHRS, Douglas, W.**
Edina, MN 55435 (US)

(74) Representative:
Graalfs, Edo, Dipl.-Ing.
Patentanwälte
Hauck, Graalfs, Wehnert, Döring, Siemons et al
Neuer Wall 41
20354 Hamburg (DE)

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D scription

Background f the Invention

1. Field f th Inventi n

[0001] This invention relates to a locking bone screw that is reversible.

2. Description of the Related Art

[0002] Bone screws are used in a great variety of applications to fix bones, bone fragments, or to act as an anchor for bone plates, rods, etc. In some applications, it is critical to prevent the screws from backing out, since their position may be near vessels, nerves or other implant components which could be damaged.

[0003] US 4,754,749 discloses a cannulated surgical screw including a threaded shaft, a head for turning the screw and a cannula extending from the head along the length of the screw. The surgical screw is prevented from counter rotation by a long, slender locking pin which is inserted into a and through an inclined hole provided through the head of the screw.

[0004] Many other attempts have been made to create a usable locking bone screw. Most are quite complicated and are not readily removable when desired. Positive locking of bone screws is very desirable, since in some applications, even minor pull-out or screw-out could cause contact with a vital structure in the body. Even of greater need is a positively locking bone screw which could be removed if desired.

Summary of the Invention

[0005] The present invention provides a simple cannulated bone screw that includes at least one side opening. A spring is inserted into the cannula while a prong is able to spring out of a side opening into the surrounding bone. The presence of the spring ends in the bone makes screw-our very unlikely since the spring ends must carve out its own threads.

[0006] It is possible to remove or reposition bone screws of this invention. One simply needs to depress the spring further down the cannula to disengage the spring ends. The screw may then be removed and repositioned.

[0007] One or more spring ends and matching side openings may be employed. The cannula may include guides to make alignment of the spring ends with the side holes easier. Generally, any bone screw design may be used which may be cannulated and made with side openings.

Brief Description of the Drawings

[0008] A detailed description of the invention is hereafter described with specific reference being made to the drawings in which:

FIG. 1 is a perspective view of a bone screw, lock spring;
FIG. 1a is an end view of the screw showing the cannula and guides;
FIG. 2 shows a typical bone break in need of repair;
FIG. 3 shows the bone of Fig. 2 being prepared for a screw;
FIG. 4 shows insertion of the bone screw typically with an allen wrench;
FIG. 5 shows insertion of a spring into the cannula after the bone screw is fully seated;
FIG. 6 is a cross-section view of lines 6.6 of Fig. 5 showing the spring insertion;
Fig. 6a is a view similar to Fig. 6 showing the spring ends projecting through side holes;
FIG. 7 shows a variant having four spring ends and side openings;
FIG. 8 is an end view of the bone of Fig. 7 showing multiple cannula spring guides;
FIG. 9 is a perspective view showing a bone screw lock with the four pronged spring to be positioned; and
FIG. 10 is a perspective view showing two 4-pronged bone screws to be positioned.

Description of the Preferred Embodiments

[0009] With reference to the figures, Fig. 1 shows a bone screw 10, spring 12, and inserting tool 14 of the invention. As seen in Fig. 1a, bone screws 10 include a cannula 16 and a head 18 which accepts an allen wrench driver. The shaft 11 of the screw 10 is threaded as shown. The cannula 16 is preferably formed with spring guides 20, 22 which makes it easier to insert the spring and to align the spring 12 in the cannula. The cannula 16 preferably extends throughout the length of the screw to allow a spring 12 to pass from one end and out the other. The cannula 16 may extend only from the head partially down the length of the screw 10.

[0010] Intermediate the ends of the bone screw 10 are a pair of opposing side openings 24, 26 which communicate with the cannula 16. The spring 12 as shown in Fig. 1, 5, 6, 6a has two ends 28, 30 (See FIG. 5) which are positioned in spring guides 20, 22 of the cannula 16. An insertion tool 14 with a U-shaped end 32 is pushed into the cannula, engaging the spring 12 and depressing it further into the cannula 16.

[0011] With reference to Figures 2-7, it will be seen that a bone fracture of bone segments 34, 36 may be readily joined with the invention. As shown in Figure 3, an opening 50 is formed in the bone which may be countersunk 52 as shown. The bone screw 10, preferably with spring 12 pre-inserted (in the springs' compressed stage), is threaded into the bone with an allen wrench or similar device to torque the screw into place as shown in Figures 5-7.

[0012] Once the bone screw 10 is at the desired depth, the inserting tool, or any device that can contact the spring 12 and depress it down the cannula 16 is employed. The inserting tool 14 as shown has a u-shaped end 32 that catches the spring 12 readily. The spring 12 is depressed down the cannula 16 until the spring ends 28, 30 are able to pass out through the side openings 24, 26 as shown in Figure 6a. The spring 12 is constructed such that the ends 28, 30 will be forced outwardly into the bone and will actually extend into the bone further than the tapped threads. This helps to lock the bone screw 10 in place, since the spring ends 28, 30 would need to tear out through bone or twist out to form an enlarged thread or groove to loosen.

[0013] Figures 7-9 show that the bone screws 10 of the invention may have multiple springs 12, spring guides 38, 40 in addition to guides 20, 22; and additional side openings. The spring 12 may be formed as a single unit with four projecting ends, each of which would pass through a matching side opening. It should be apparent that a single spring end up to many spring ends may be employed.

[0014] Figure 10 shows a bone screw 10 having two separate side openings 44, 46 that are spaced apart along the shaft. In this form, a spring 12 may be inserted until the spring ends 28 project through opening 44 to lock into bone. If the depth of the screw must be readjusted, but not removed, the spring is simply depressed down the shaft to disengage the lock. The screw could then be positioned deeper and the spring would be advanced down to opening 46 to relock. This also makes it easy to reuse the screw if it needs to be removed for repositioning.

[0015] If the bone screw needs to be removed for any reason, other locking bone screws are nearly impossible to remove. With the device of the invention, one simply depresses the spring 12 further down the cannula 16 so the spring ends 28, 30 re-enter the cannula and are held fully inside the device.

[0016] The bone screw and spring may be formed from any biocompatible material such as is well known in the art. Stainless steels, titanium and nitinol alloys are examples for both the screw body and the spring. The spring may be formed to provide more or less outward spring force.

[0017] Any bone screw that may be cannulated may be modified to benefit from this invention. Primarily, bone screws intended for use in cancellous bone may use this invention.

[0018] While this invention may be embodied in many different forms, there are shown in the drawings and described in detail herein specific preferred embodiments of the invention. Procedures that may employ the inventive devices include bone plate fixation generally, pedicle screw use, tibial tray fixation, cervical plate fixation, total hip acetabular cup fixation and intramedullary rod fixation. The present disclosure is an exemplification of the principles of the invention which is not intended to be limited to the particular embodiments illustrated and is defined by the appended claims.

Claims

1. A reversible cannulated bone screw (10) including a threaded shaft (11), a head (18) for turning said screw and a cannula (16) extending from said head along the length of said screw, characterized by:

   a) at least one side opening (24, 26) formed through said threaded shaft to communicate with said cannula,
   b) a spring (12) including at least one spring end (28, 30) inserted into said screw cannula, said spring being constructed and arranged such that depression of said spring down said cannula away from said head causes at least one spring end to project through at least one of said side openings, said spring further being constructed and arranged such that once inserted into said cannula, no portions extends above the screw head, and that by further depressing the spring distally, the spring disengages the bone so that the screw may be removed or repositioned.

2. The bone screw of claim 1, wherein said at least one side opening includes a pair of opposed side openings (24, 26), said spring including two spring ends (28, 30), each of which may extend through a side opening.

3. The bone screw of claim 2, wherein said cannula includes locating means (20, 22, 38, 40) for inserting said spring within said screw such that said spring ends align with said side openings.

4. The bone screw of claim 3, wherein said spring is a generally V-shaped spring wire.

5. The bone screw according to one of the claims 1 to 4, characterized in that said cannula includes opposing spring guide grooves (20, 22, 38, 40) extending from said head to said side openings (24, 26; 44, 46) for guiding said spring ends (28, 30) to said side openings, said cannula extending from said head distally of said side openings such that said spring ends may re-enter the cannula distally of the side openings.

6. The bone screw according to one of the claims 1 to 5, wherein said shaft includes a second pair of side openings (46) spaced directly distally of said first side openings (44).

Pat ntansprüch

1. Reversible, rohrförmige Knochenschraube (10), die einen Gewindeschaft (11), einen Kopf (18) zum Drehen der Schraube und ein Rohr (16) aufweist, das sich von dem Kopf entlang der Länge der Schraube erstreckt, gekennzeichnet durch

   a) mindestens eine Seitenöffnung (24, 26), die durch den Gewindeschaft zur Verbindung mit dem Rohr geformt ist,
   b) eine Feder (12), die mindestens ein Federende (28, 30) einschließt, das in den Schraubenkanal eingesetzt ist, wobei die Feder aufgebaut und derart angeordnet ist, daß ein Herunterdrücken der Feder in dem Kanal fort von dem Kopf mindestens ein Ende der Feder dazu bringt, aus mindestens einer der Seitenöffnungen vorzustehen, wobei die Feder zusätzlich aufgebaut und angeordnet ist derart, daß, einmal in den Kanal eingesetzt, keine Abschnitte über den Schraubenkopf vorstehen, und daß durch ein weiteres Herunterdrücken der Feder in distaler Richtung, die Feder außer Eingriff mit dem Knochen gelangt, so daß die Schraube entfernt oder neu ausgerichtet werden kann.

2. Knochenschraube nach Anspruch 1, dadurch gekennzeichnet, daß mindestens eine Seitenöffnung ein Paar von gegenüberliegenden Seitenöffnungen (24, 26) einschließt, wobei die Feder zwei Federenden (28, 30) aufweist, von denen sich jede durch eine Seitenöffnung erstrecken kann.

3. Knochenschraube nach Anspruch 2, dadurch gekennzeichnet, daß das Rohr Zentriermittel (20, 22, 38, 40) zum Einführen der Feder in die Schraube aufweist derart, daß die Federenden mit den Seitenöffnungen ausgerichtet sind.

4. Knochenschraube nach Anspruch 3, dadurch gekennzeichnet, daß die Feder einen im wesentlichen V-förmiger Federdraht aufweist.

5. Knochenschraube nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß das Rohr einander gegenüberliegende Federführungsausnehmungen (20, 22, 38, 40) aufweist, die sich von dem Kopf zu den Seitenöffnungen (20, 26; 44, 46) erstrecken, um die Federenden zu den Seitenöffnungen zu führen, wobei das Rohr sich von dem Kopf distal von den Seitenöffnungen derart erstreckt, daß die Federenden wieder in das Rohr eintreten können distal von den Seitenöffnungen.

6. Knochenschraube nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der Schaft ein zweites Paar von Seitenöffnungen (46) aufweist, die direkt distal von der ersten Seitenöffnung (44) angeordnet sind.

R v ndicati ns

1. Vis d'ostéosynthèse réversible cannulée (10) comprenant une tige filetée (11), une tête (18) pour tourner ladite vis et une canule (16) s'étendant depuis ladite tête sur la longueur de ladite vis, caractérisée par :

   a) au moins une ouverture latérale (24, 26) formée à travers ladite tige filetée afin de communiquer avec ladite canule,
   b) un ressort (12) comprenant au moins une extrémité de ressort (28, 30) insérée dans ladite canule de vis, ledit ressort étant conçu et disposé de telle sorte qu'un enfoncement dudit ressort dans ladite canule à l'écart de ladite tête amène au moins une extrémité de ressort à dépasser à travers au moins l'une desdites ouvertures, ledit ressort étant en outre conçu et disposé de telle sorte qu'une fois inséré dans ladite canule, aucune partie ne s'étende au-dessus de la tête de vis, et qu'en enfonçant davantage le ressort de façon distale, le ressort se dégage de l'os de sorte que la vis peut être enlevée ou repositionnée.

2. Vis d'ostéosynthèse selon la revendication 1, dans laquelle ladite au moins une ouverture latérale comprend une paire d'ouvertures latérales opposées (24, 26), ledit ressort comprenant deux extrémités de ressort (28, 30), dont chacune peut s'étendre à travers une ouverture latérale.

3. Vis d'ostéosynthèse selon la revendication 2, dans laquelle ladite canule comprend un moyen de positionnement (20, 22, 38, 40) destiné à insérer ledit ressort à l'intérieur de ladite vis de telle sorte que lesdites extrémités de ressort s'alignent avec lesdites ouvertures latérales.

4. Vis d'ostéosynthèse selon la revendication 3, dans laquelle ledit ressort est un fil d'acier à ressort sensiblement en forme de V.

5. Vis d'ostéosynthèse selon l'une des revendications 1 à 4, caractérisée en ce que ladite canule comprend des rainures de guidage de ressort opposées (20, 22, 38, 40) s'étendant depuis ladite tête vers lesdites ouvertures latérales (24, 26 ; 44, 46) en vue de guider lesdites extrémités de ressort (28, 30) vers lesdites ouvertures latérales, ladite canule s'étendant depuis ladite tête de façon distale desdites ouvertures latérales de telle sorte que lesdites extrémités de ressort peuvent pénétrer à nouveau

dans la canule de façon distale dans les ouvertures latérales.

6. Vis d'ostéosynthèse selon l'une des revendications 1 à 5, dans laquelle ladite tige comprend une seconde paire d'ouvertures latérales (46) directement espacées de façon distale desdites premières ouvertures latérales (44).

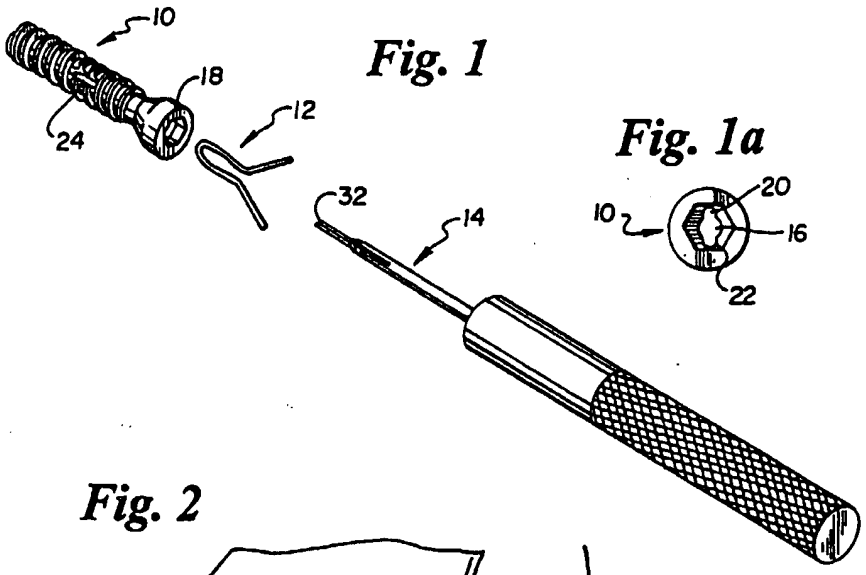

Fig. 1

Fig. 1a

Fig. 2

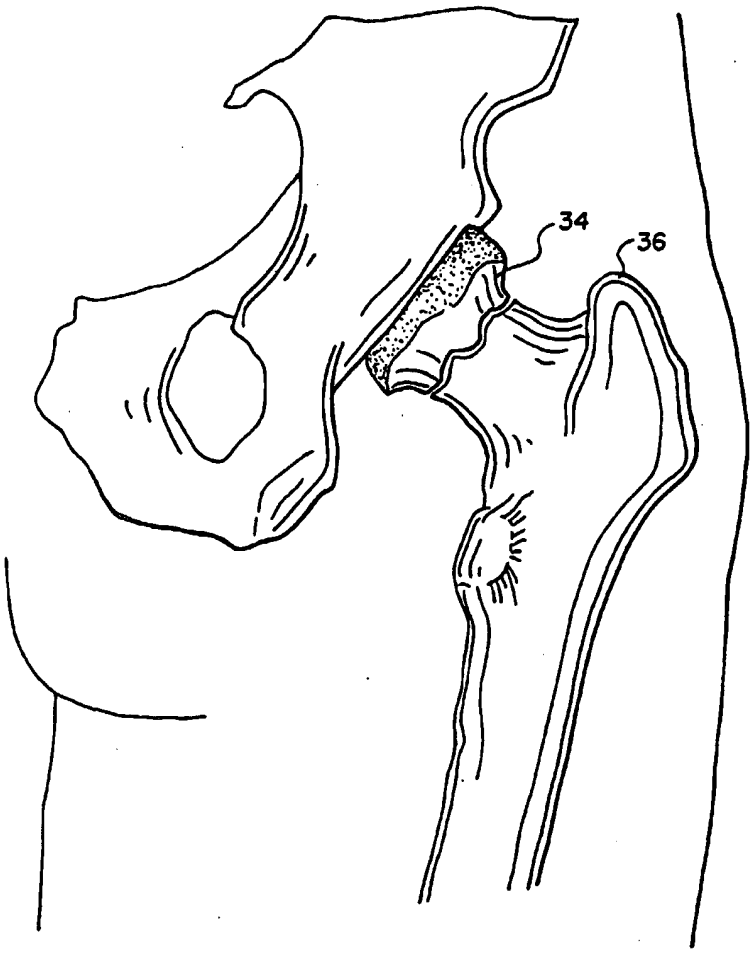

Fig. 3

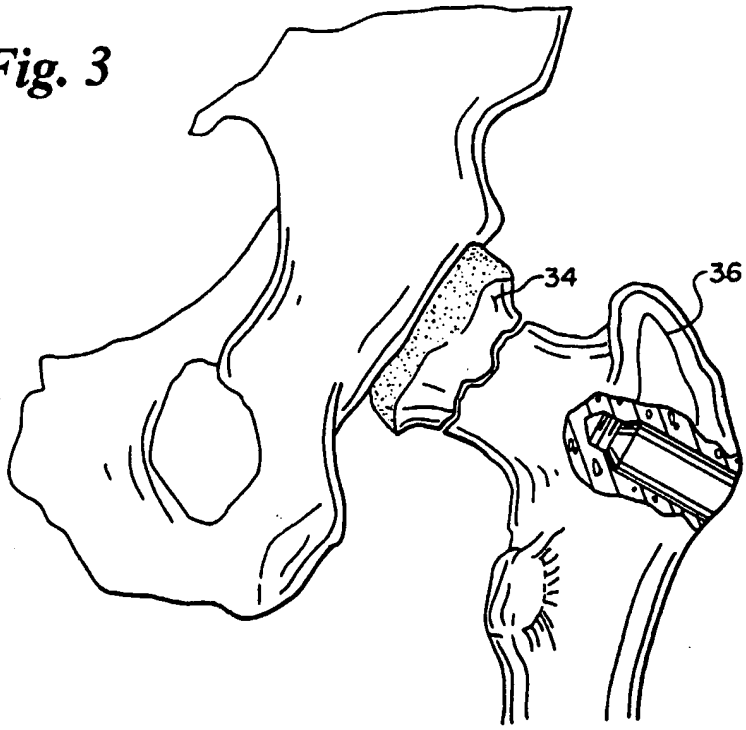

Fig. 4

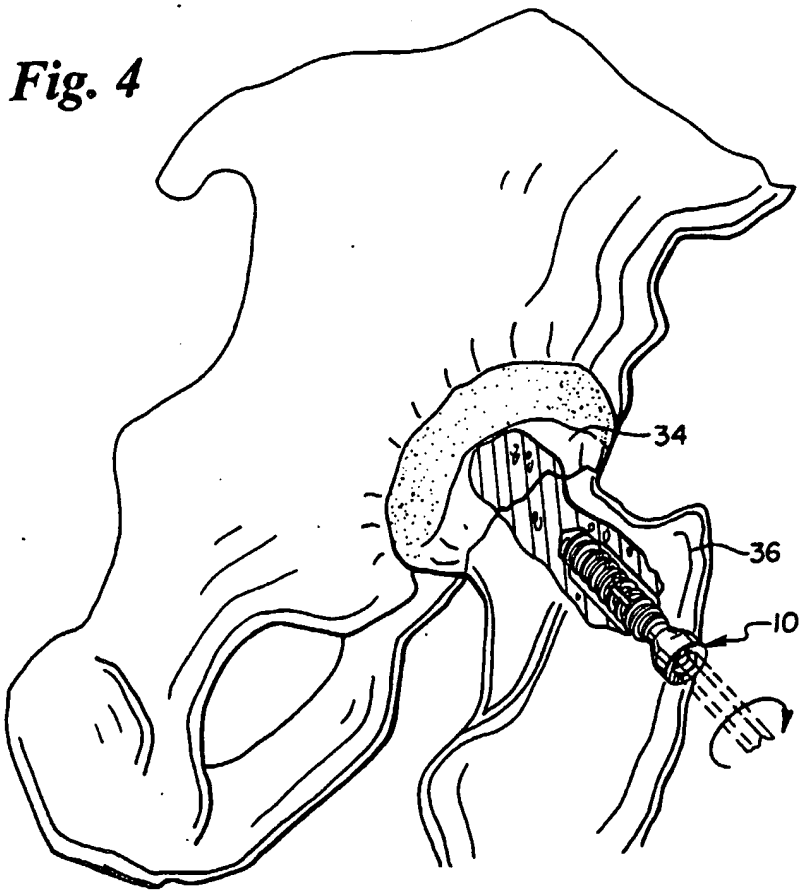

Fig. 5

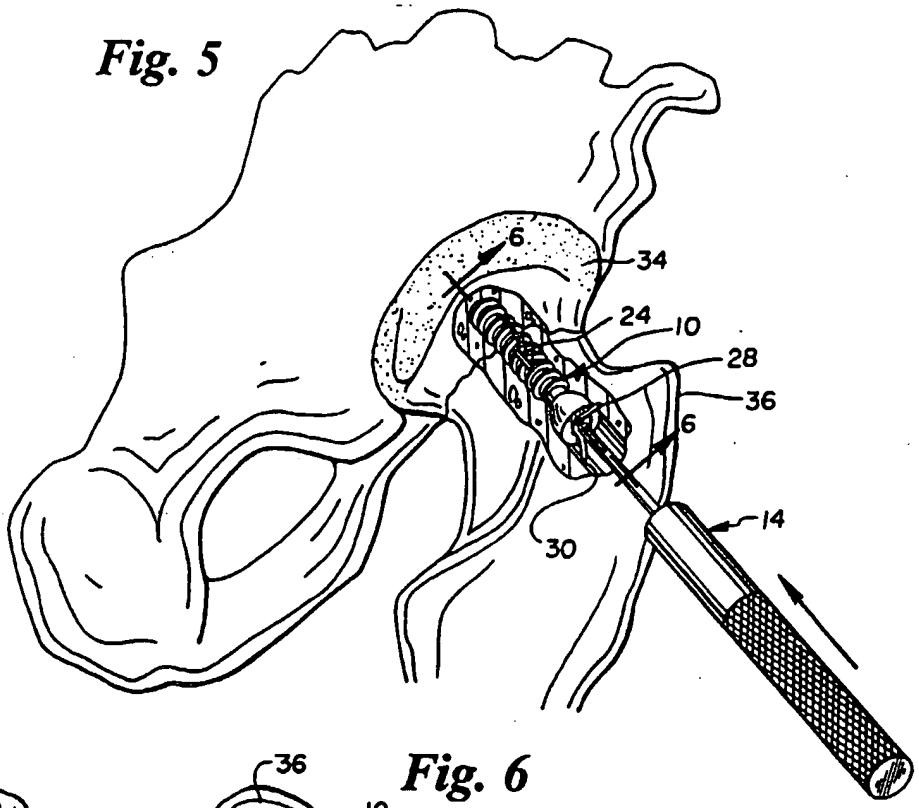

Fig. 6

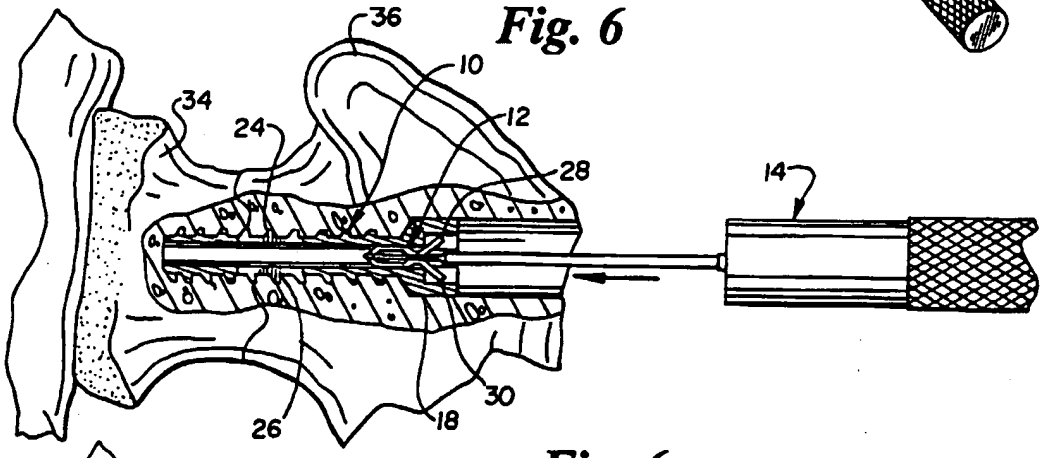

Fig. 6a

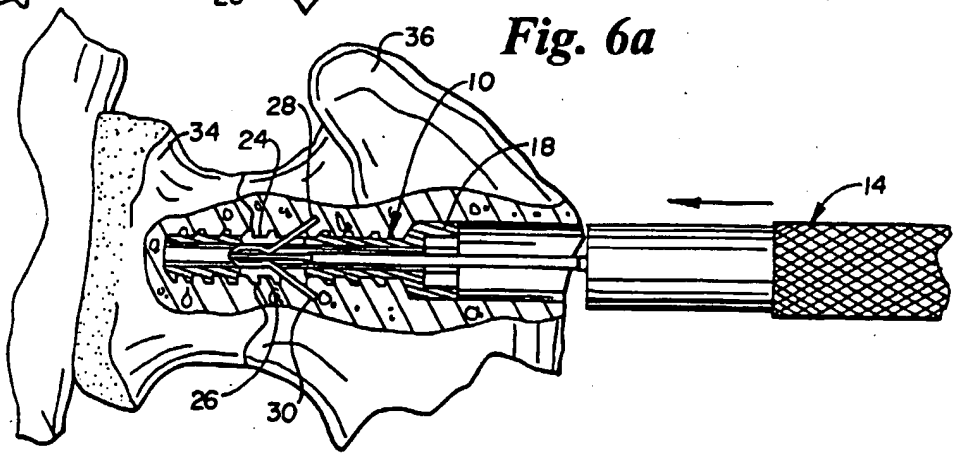

Fig. 7

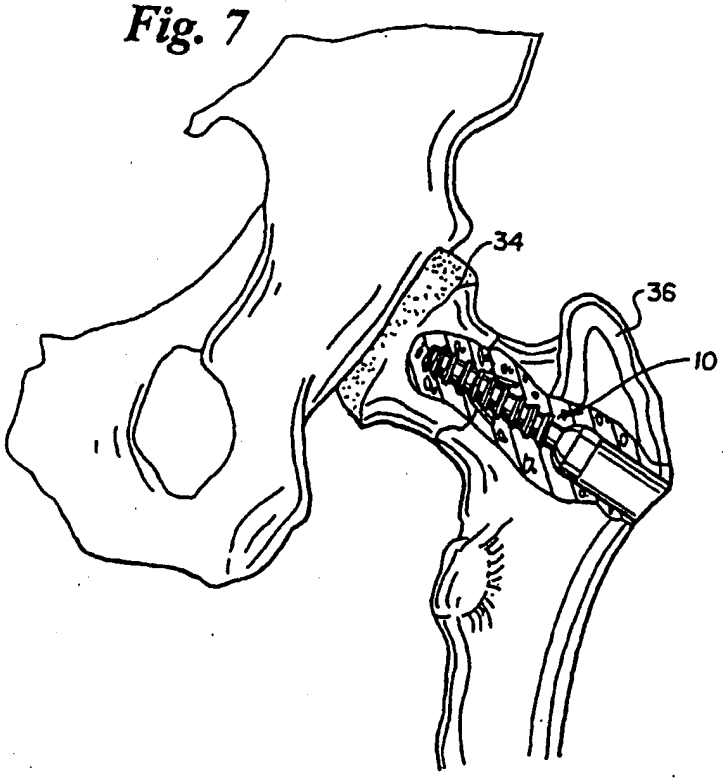

Fig. 8

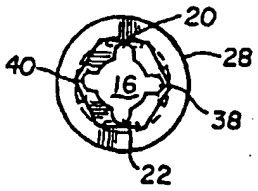

Fig. 9

Fig. 10